

## EVIDENCE FOR A CENTRAL DEPRESSION IN THE REAL PART OF THE PROTON OPTICAL POTENTIAL

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The differential cross sections and analyzing powers for 200 MeV protons elastically scattered from  $^{12}\text{C}$  have been measured in the angular region  $6^\circ$ - $115^\circ$ . The data were analyzed in terms of local, complex, spin-dependent optical potentials. Four different formulations of the potential have been tried. Using the standard Woods-Saxon (WS) shape for the central

terms and the Thomas form for the spin-orbit potential resulted in an acceptable fit to the data at  $\theta < 60^\circ$  but failed to describe the features of the data beyond  $60^\circ$ . An investigation of different parametrizations of the potential led to the conclusion that it is the restricted shape of the WS form which prevents the optical model from describing the data at large angles. As shown in Fig. 1, the best standard WS fit (dashed line) is improved, especially for the cross section at large angles, if a more flexible potential shape is used (solid line, obtained by replacing the attractive WS by the sum of two WS forms, one attractive, the

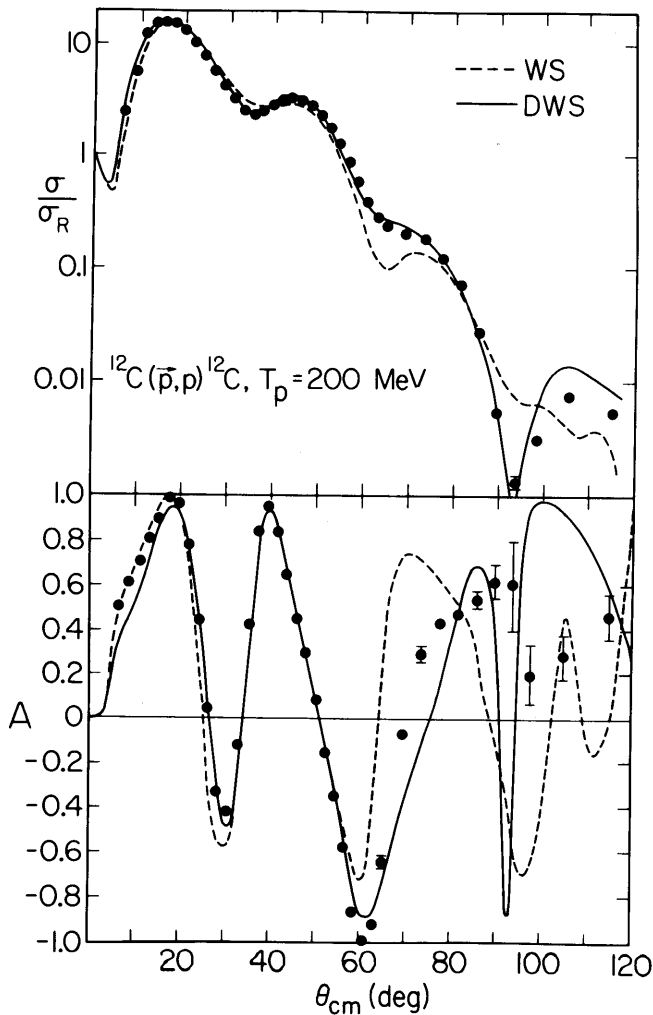


Figure 1. Phenomenological optical-potential fits to the  $\bar{p}+^{12}\text{C}$  data with a simple Woods-Saxon (WS) and a double Woods-Saxon (DWS) parametrization of the central potentials.

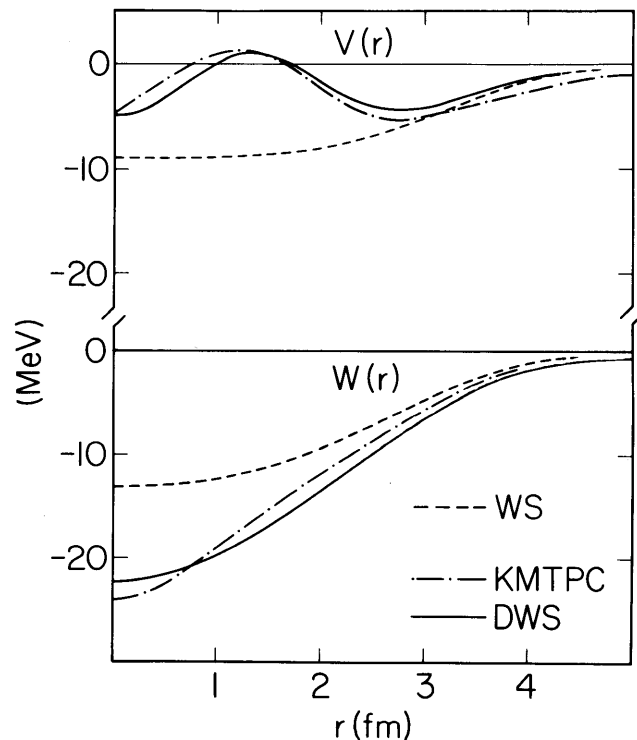


Figure 2. Radial distributions of the real and imaginary central potentials  $V(r)$ ,  $W(r)$  for the simple WS and double-WS (DWS) parametrization. The KMTPC curves are results of data fits for a KMT impulse-approximation potential with (empirical) Pauli corrections.

other repulsive). One particular feature which is common to all potentials which were able to reproduce large-angle data is that the real part of the central potential is drastically reduced for  $0 < r < 2\text{fm}$ . Associated with this reduction in central attraction is a substantial increase in central absorption. The resulting potentials are illustrated in Fig. 2. This result supports predictions of microscopic theories for the proton-nucleus optical potential.<sup>1,2,3)</sup> According to these predictions, the observed reduction of the

real potential is typical for the bombarding energy region of this experiment. A more detailed account of this work has been published.<sup>4)</sup>

- 1) C. Mahaux, Proceed. Banff NATO Summer Institute (Banff, 1978), p. 265.
- 2) H.V. von Geramb, T.A. Brieda and J.R. Rook, Proceed. Conf. on Microscopic Optical Potentials (Hamburg, 1978), p. 104.
- 3) M. Jaminon, C. Mahaux and P. Rochus, Phys. Rev. C22, 2027 (1980).
- 4) H.O. Meyer, P. Schwandt, G.L. Moake and P.P. Singh, Phys. Rev. C23, 616 (1981).

#### ELASTIC SCATTERING AT HIGH MOMENTUM TRANSFER AS A TEST OF A MICROSCOPIC POTENTIAL THEORY

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Recently, cross sections and analyzing powers of elastic  $^{12}\text{C}(\vec{p}, p)^{12}\text{C}$  scattering at 200 MeV have been measured at IUCF.<sup>1)</sup> The data have been analyzed<sup>2)</sup> in terms of a microscopically-derived local optical potential. This potential has been derived by phase equivalence from the intrinsically non-local nucleon-nucleus potential using a density-dependent nucleon-nucleon (NN) t-matrix.<sup>3)</sup> Figure 1 demonstrates that the agreement of this theory (solid line) with the previously known data (solid dots) is quite respectable in view of the fact that there are no adjustable parameters (also shown in Fig. 1 are phenomenological analyses, discussed in another contribution to this report). The most dramatic feature of the calculation, however, is the predicted rise of the backward cross section. This stimulated the following additional measurements at large scattering angles.

The experiment was carried out with an unpolarized beam and an enriched  $^{12}\text{C}$  target ( $130\text{ mg/cm}^2$ ), using the QDDM spectrograph. The usual focal-plane detector array was supplemented by two small-area scintillators positioned along the central ray leaving the QDDM and

placed in a 3-fold coincidence in order to reduce the background due to neutron reactions in the detectors. The acceptance of this detector system was sufficient to contain the elastic proton group and allowed the measurement of cross sections as small as  $2\text{nb/sr}$ . The data obtained in this manner are displayed in Fig. 1 as open circles.

Clearly, the microscopic model<sup>2)</sup> fails the test in a comparison with the new data: the backward cross sections are overestimated by 1-2 orders of magnitude. It has to be pointed out, however, that the new measurements cover an unprecedented range of momentum transfer ( $4\text{--}6\text{ fm}^{-1}$ ). It is well possible that the high-momentum components of the NN potential employed (Hamada-Johnston) are not really constrained experimentally and may allow for sufficient adjustment. Theoretical efforts along this line are in progress<sup>4)</sup>. Furthermore, it will be necessary to assess the influence of the coupling to the  $2^+$  (4.4 MeV) state in  $^{12}\text{C}$  (which dominates the excitation spectrum at large angles) and to study the uncertainties introduced by the spin-orbit potential which at present is not well